

Ad hoc Committee reply to: “Measurement of deeply virtual Compton scattering off Helium-4 with CLAS at Jefferson Lab”

Committee: Axel Schmidt (chair), Harut Avakian, Zein-Eddine Meziani

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The committee met on July 2, 2020, to discuss our concerns about the manuscript. We are separating out our comments on English, wording, typographical errors, etc., as helpful suggestions for you, which do not need any response. However, there are a few areas of concern where we would like a response before we can approve the manuscript. In some cases, we would appreciate a direct answer or some clarifying information. In others, we recommend changes to the manuscript to make it more clear and easier to read. In any case, please note your response and any manuscript changes in a written document *in addition* to any discussion between the committee and the authors by e-mail, so that the response can be preserved in the official record.

1. As this is a long paper, giving more details about two published letters, we’d appreciate some statement as to whether or not anything in the analysis has changed between this paper and the two previous papers? Did the systematic error decrease? Did the central values of the results move in any case more than 1σ of their former error. Perhaps it would be good to state the changes/improvements achieved in this new publication.
2. We have concerns about how you describe your approach to the π^0 contamination, especially in the incoherent channel.

(a) In Figs. 14 and 15, bottom right panels, what is the definition of the ϕ angle? Is this the ϕ angle of the π^0 ?

(b) What kind of input distributions went into the π^0 generation to produce the ϕ -dependence of Figs. 14 and 15.

(c) We feel that it would be more useful to see the ϕ distribution calculated (from simulation) from the single detected photons, i.e., what the ϕ -distribution of your actual background looks like.

(d) In lines 280-282, you write “To make the correction on the DVCS BSA, we assume that the exclusive π^0 production has no such asymmetry. This has been checked with the exclusive π^0 production data, for which no significant level of BSA was measured.”

There are couple of issues here. First, this claim is contradicted by CLAS data on protons, for example <https://arxiv.org/pdf/0711.4736.pdf>, which observed 5–10% BSA over a wide kinematic range.

Second, even if you check with your own exclusive π^0 data and see no BSA, this claim is only so good as the precision of your check, and there must be some systematic uncertainty associated with the possibility of a BSA below your ability to detect. This needs to be explained in the paper.

(e) It would be helpful for you to write a few words explaining the differences in the assumed π^0 distributions for the coherent and incoherent cases.

3. Regarding the final state interaction discussion starting at approximately line 100—the issue is a nucleonic final state interaction issue, and we are not sure why DIS is mentioned here as a reference. There must be people who spent their time investigating the $A(e, e'p)X$ nucleonic final state calculations, for example, that might inform us on these effects. Perhaps adding a more relevant reference would help.
4. In Section 4.1, your choice to use the present tense here is quite jarring, especially since you don’t make a distinction between the original CLAS, the upgraded CLAS-12 detector. Please consider switching to past tense here and making that distinction explicit. Furthermore, it would be good to state that these data came from the EG6 run period, and give the year that they were collected.

5. Line 147: “Its historic use to measure DVCS in many different configurations made it an ideal place for this new DVCS measurement.”

This is not an informative claim. CLAS can be ideal for DVCS for many reasons, but you’re pretty much giving a tautology here.

6. Section 5.1: “In particular, it serves for the identification of the protons.”

Are you referring to the time-of-flight detection of the electron or the proton? Perhaps separate sections for electron ID and proton ID are warranted. Furthermore, you have no section on the ID of ^4He in the RTPC. We know that this is covered in the RTPC NIM, but a paragraph would be nice.

7. Line 238: “In principle, a selection based on two or three variables can be used to guaranty the exclusivity of the process.”

In exclusive DVCS, you measure the momentum vectors of 3 particles of known ID, i.e. 9 quantities. Exclusivity requires both energy and momentum conservation, i.e. 4 constraints. Where do “2 or 3” come from? That is a vague statement.

8. Line 302: “As it is not obvious which solution is best...”

What is obvious is that this is not an issue of correct or incorrect, but one of possible bias introduced to your BSA from your poor t resolution. Please rephrase the paragraph in these terms, and state what systematic uncertainty is introduced from the limitations in your ability to reconstruct t . If this effect introduces negligible uncertainty on the BSA, that’s fine, but make that argument clear.

9. Table 1 is mildly misleading, simply because the beam polarization is a *relative* uncertainty, while the others are absolute uncertainties (if we understand correctly). Perhaps it is better to pull beam polarization out of the middle of the table and put it somewhere else so it can be understood as distinct.

That 3.5% is a multiplicative factor, right?

10. Eq. 25 appears to have a mis-print. x_A should be x_A .

English and Typographical suggestions

- Line 4: “...was incident on a pressurized...”
- Line 6: “was upgraded...”
- The abstract is full of passive-voice constructions and could be made more engaging.
- Line 17: (TMDs) rather than (PDF)
- Line 20: Since PDF was used before the reader wouldn’t know it is nuclear longitudinal pdfs since PDF fwas used for TMDs earlier.
- Line 26: “With a nuclear target of spin-0” → “With spin-0 nuclear targets”
- Line 27: intervening → would replace with “occurring”
- Line 28: Conjunction is missing
- Line 28: “...from the HERMES...” → “by the HERMES...”
- Line 29: “lead” → “led”
- Line 40: “The different spin states possible” → “The different possible spin states”
- Line 47: “...in full phase space parameters.” → “...in the full phase space of parameters.”
- Eq. 1 is not actually an equation. Is that a cross section? An asymmetry? Right now, it’s just a term.
- Line 53: “...probe do not differentiate...” → “...does not differentiate...”
- Line 55: “The DVCS” → “DVCS”

- Line 80: “associated to the GPD” → “associated with the GPD”
- Line 91: “...large mass of the helium nuclei.” → “...large mass of the helium nucleus.”
- Fig. 6: explain the gray band in the caption
- Fig. 7: Mention what type of errors are reported on the figure because for example in the upper panel we have points with double horizontal ticks.
- Line 117: “Suffer from large error bars” → “Suffer from large uncertainties”
- Line 132: “impaired the measurement...” → “impaired the interpretation of the measurement...”
- Line 136: “...objective...” → “...objectives...” There are at least two objectives in the sentence.
- Line 145: “The CLAS...” → “CLAS is installed in Experimental Hall B of the Jefferson Lab Continuous Electron Beam Accelerator Facility (CEBAF).”
- Line 151: “charge particle’s” → “charged particles’ ”
- Line 151: “... behind drift...” → “... behind the drift...”
- Line 154: “... complimented ...” → “... complemented...”
- Line 160: “... rate ran around 3 KHz...” → “... the data aquisition operated at a rate of about 3 KHz...”
- Line 164: “lead to” → “has been employed for.”
- Line 223: “Left over accidentals, will...”
 - → remove comma
 - → Future tense is not appropriate. Yes, the work is described later in the text, but it has work that has already been completed, and is merely being recounted here. Consistent present or past tense is appropriate.
- Line 225: “from their two photons decay” → “from their decay into two photons.”
- Line 239: “guaranty” → “guarantee”
- Line 248, and again on 249: “system electron-helium” → “electron-helium system”
- Line 258: “... are largely ...” → “... are mainly...”
- Line 299: “... in the Fig. 5...” → “... in Fig. 5 ...”
- Line 313: “... is a necessity ...” → “... is necessary ...”
- Line 324: “one of the promise of” → “one of the promises of” ... or “premises”?
- Figure 19: For clarity of Fucini calculation, use a dash-dotted line.
- Line 325: “We presente ...” → “We present ...”
- Line 341: “far behind the experimental results on proton target ...” → “far behind the experimental results of the proton...”
- Line 353: “issues to reproduce” → “issues reproducing”
- Line 360: “... the different results with the raw asymmetries was linked ...” → “... the different raw asymmetry results obtained were linked ...”
- Tables 2 to 7: The number of quoted significant digits in the asymmetries and their errors is absurd and should be appropriate adjusted.
- Also, Try replacing ‘<’ and ‘>’ with ‘\langle’ and ‘\rangle’